UL Solutions

Validating recycled content: Choosing the correct methodology

Recycled content validation evaluates your products' post-consumer, pre-consumer (post-industrial), closed loop or overall recycled content. But the way that evaluation is completed makes all the difference.

Executive summary

The popularity of green product marketing has caused a rise in eco-label use. According to McKinsey, "across all end-use segments, 60 to 70 percent of consumers said they would pay more for sustainable packaging. A willingness to pay more was relatively equally distributed across end-use segments"[1]. But an increase in the use of eco-labels makes it difficult to differentiate between genuine environmentally preferable products and those that aren't. In fact, the 2023 Green Buying Report finds that "46% of consumers said unclear labeling is a barrier they face when thinking about purchasing products with sustainable features"[2].

What is recycled content? Recycled content is material that has been recovered (reclaimed) from previously used goods and reprocessed. This reprocessed material is then made into a new final product or component for incorporation into a finished product. Two types of recycled content are most commonly used in industry. Pre-consumer (post-industrial) recycled material (PIR) is material that has never reached the end user, having been diverted from the waste stream generated during a manufacturing process.

It is discarded material and with some additional processing it can be reused as a substitute for a raw material. Post-consumer recycled material (PCR) is material reclaimed from products, that had been used for its intended purpose, has reached the end-of-life and is no longer being used.

Polyethylene terephthalate (PET) is one of the most recycled polymeric materials globally[3], and is most commonly used in food and beverage containers. It is also known as polyester when used in textile, accounting for 52% of total volume of fibers in 2020. Today, only ~15% of global PET textile market is represented by recycled inputs, mostly from post-consumer PET bottles.[4] Both beverage container and textile industries have established goals around recycled content[5][6] driving demand for verified rPET. With a rising demand for recycled materials, there is evidence that virgin polyester is being sold with a claim of recycled PET (rPET). It is estimated that more than 50% of what is marked and sold as rPET is made from virgin polyester.[7]

Through rigorous scientific analysis and review outlined in globally accepted standards, an independent validation of recycled content can help manufacturers and retailers demonstrate to the marketplace that their products do, in fact, live up to their environmental claims and do not perpetuate greenwashing. Unbiased, third-party evaluation gives manufacturers instant credibility and a clear advantage in a competitive marketplace.

However, among the several recycled content validation methods that exist, which is the most reliable and accurate? This whitepaper aims to elucidate why UL Solutions uses a chain of custody (CoC) model as part of our Environmental Claim Validation Program for Recycled Content using the UL 2809 series of standards for validation rather than a testing model.

The CoC model applied follows ISO 22095, providing a consistent generic approach to the design, implementation and management of chains of custody with the aim of tracking specified characteristics like recycled content from a defined source along a manufacturing

supply chain. As described in ISO 22095:2020, "Chain of custody systems have become an indispensable element of many different applications, such as certification schemes for food safety, sustainable agriculture, forestry, aquaculture or fisheries, social compliance, manufacturing, construction and mineral mining. They enable information associated with a product and/or production characteristics to be shared among various organizations active in the chain of custody. Examples for active organizations within a chain of custody are material and ingredient suppliers, processors, contractors, transportation companies, (private or regulatory) scheme owners, financial institutions, companies active in refurbishing and recycling, governmental organizations, end customers, and consumers or other end users".[8]

The auditing procedures for CoC models found in ISO 22095 are used in UL 2809, the Standard for Environmental Claim Validation Procedure (ECVP) for Defined Source Content, enabling the validation of distinct types of recycled content and by-product synergies in complex supply chains.

Demand/supply

2018 supply of recycle plastic and total demand and in U.S. & Canada
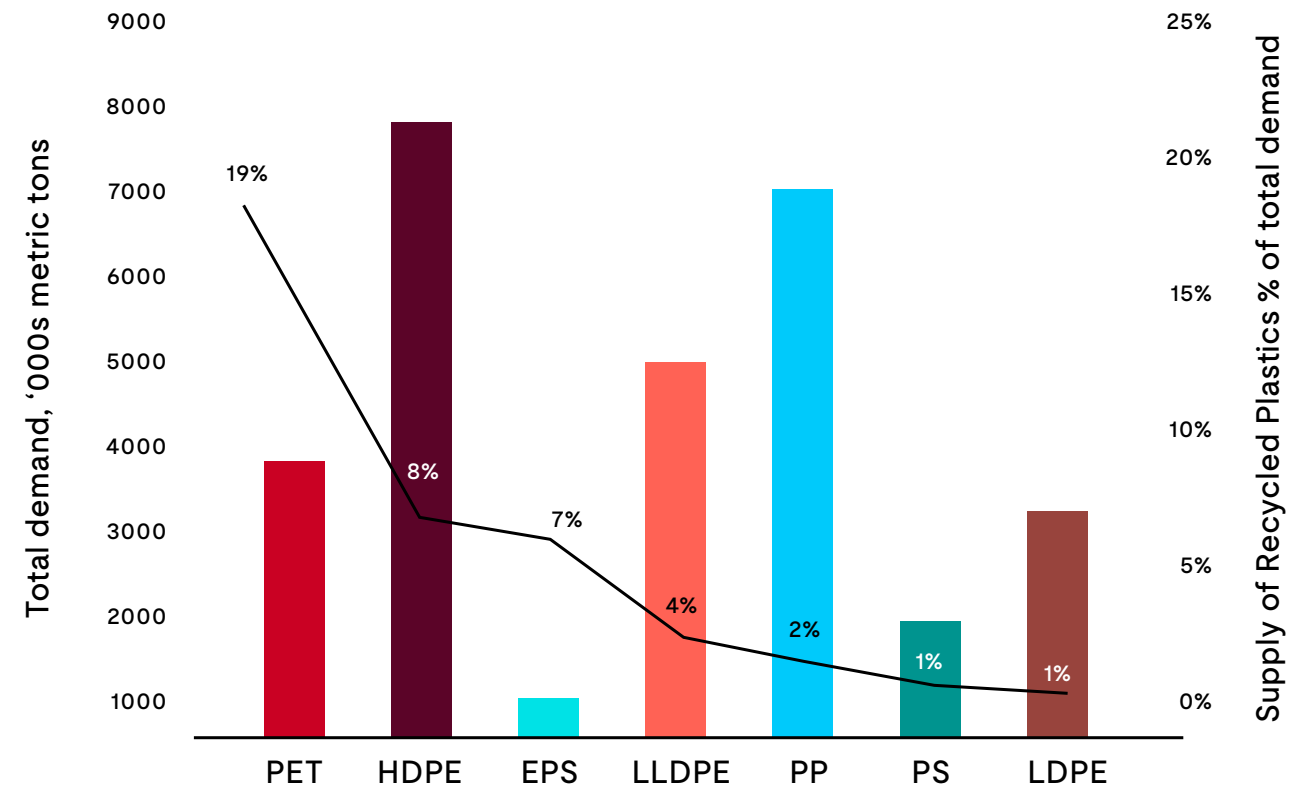
Review of methodologies

After in-depth scientific investigation on PET,[9] UL Solutions has found that auditing the CoC to track the recycled content in PET along a supply chain is more reliable than any type of testing to validate the recycled content of a product. Through manufacturing advancements and innovation, products manufactured from recycled content indistinguishable as products manufactured from virgin content, independent from the material types (metal, glass or plastics) that disables the use of any analytical testing method in this case. This is beneficial to the consumers, of course, but results in significant hurdle for meaningful use of testing for recycled content.

In the case of PET, recycled content validation using analytical testing methods evaluates the presence of a tracing marker, e. g. isophthalic acid (IPA) that is added to plastic as co-polymer to control the optical properties, making PET transparent by inhibiting crystallization that would otherwise make the polymer opaque. During the scientific investigation,[6] we ran a global study of 32 different types of PET plastics, both virgin and recycled, and found that testing for the presence of IPA alone was not a reliable method. Our study did not find a strong correlation between the presence and quantity of the tracing marker and whether the material was recycled.

A chain of custody method attempts to track the recycled content from the consumer's recycling bin to the reclamation site to the manufacturer, etc. The tracking follows each stage through sourcing, processing, trading, and distribution as the material progresses from stage to stage of the supply chain and changes ownership.

The following is a brief review of the CoC methodology types:

Identity preserved (IP) method
The simplest method of CoC tracking is identity preserved (IP). Verified recycled content is purchased directly from a single vendor and is used to make the final product without further aggregation or mixture with material from other sources. The advantages of this model include:

- The ability to extract a premium due to the added value of the single source traceability
- Consumer confidence in traceability

- Uniqueness of defined source content captured and maintained

The disadvantages of this model include:

- Logistical effort of the strict separation from other sources
- If the single supplier faces supply issues, there are no other suppliers.

Segregated (S)
The segregated (S) method is like IP, but with multiple verified suppliers for the same defined source content material, i.e., recycled content. If the materials from the different sources are verified for carrying the same specific characteristics, their mixing does not affect the specific characteristics. The advantages and disadvantages of this method are the same as IP, but manufacturers are less reliant on one supplier.

Controlled blending (CB)
The controlled blending (CB) method features the use of suppliers of both virgin and recycled content. Recycled and non-recycled materials are combined in a constant

ratio, resulting in a known percentage of recycled content in each product. The advantages of this method include a more robust supply chain but require diligent record-keeping and stringent manufacturing processes to ensure the declared recycled content ratio is obtained throughout the manufacturing process.

Mass Balance (MB)

In the mass balance (MB) method, the manufacturer is aware of the percentage of recycled content it is using in its processes but not necessarily how much makes it into a particular unit or batch of units. This can be thought of in terms of baking chocolate chip cookies. The baker knows that they have used a known amount of chocolate chips in their batter, but how many chips each cookie contains is up to random chance. Overall, however, the cookies all contain some number of chocolate chips. The advantages of this model include sourcing flexibility and the support of large scale, continuous production processes in which the recycled and the virgin input material are similar and can be mixed at any ratio. This method can be more easily misused, so greater accountability may be required.

Book and Claim (B&C)

UL2809 does not currently include the book and claim (B&C) methodology.. It can be thought of in a similar way to renewable energy credits in a cap-and-trade arrangement, as there are no requirements for a linkage between the material flow and the flow of the specific characteristics transferred into a credit to be traded separately from the material. While in the end, the percent of recycled material for the manufacturer is correct, there is no way to determine if an individual product has that recycled content in it.

CoC model complexities

Several factors impact the effectiveness of the CoC methodology for recycled content validation. However, even with these complexities, it remains the most effective way to evaluate the recycled content in a material or product.

Supply chain complexity

While growing market complexity and the scattered nature of today's supply chains prove to be a great challenge, consumer expectations of the veracity of recycled content claims and legal and regulatory scrutiny make understanding and gaining control of the supply chain a business imperative. As global expansion becomes the norm, the lack of visibility and insight can have devastating impacts on competitiveness, profitability, and brand reputation. Therefore, managing of your supply chain base is critical to having an efficient and effective system for the manufacturing of recycled products.

The supply chain has become truly global and complex. Even the smallest of components could originate from another continent and progress through many other countries before the product hits the shelf. Supply chain audits help companies of all sizes identify potential risks and process

improvements. An ideal supply chain audit will provide:

- An accurate and comprehensive assessment of the supply chain
- A detailed analysis of the opportunities available to and the risks faced by an organization
- Reporting from an independent, third-party service provider with proven efficacy and acceptance from code authorities.

This is even more important with regard to a CoC methodology for recycled content. Fully understanding and having verified documentation about your supply chain is critical to an acceptable CoC.

Conclusion

The growing demand from various stakeholders to increase the use of recycled content leads to rising recycled content materials claims in the market. Thus, leading also to a potential increase in false recycled content claims, creating the need for reliable validation. Current test methodologies are found to lack reliability in verifying recycled content in a product. Existing approaches in verifying the chain of custody within a supply chain enables the required transparency validating recycled content more reliably. With adequate control of and insight into a manufacturer's supply chain, the chain of custody method of recycled content validation can be an effective means to evaluate recycled material claims. The drivers for producing recycled materials are coming from all types of stakeholders. And demand is quickly outpacing supply. Validating recycled content minimizes risks, provides consumer confidence and adds value to your product line and brand. UL Solutions is here to support businesses that are pursuing circularity objectives to meet growing demand and policy/regulatory requirements for use of recycled content.

End notes

1. McKinsey – Sustainability in packaging: Inside the minds of US consumers – 2020

2. Trivium Packaging – Buying Green Report – 2023

3. OECD: Global Plastics Outlook – Economic Drivers, Environmental Impacts and Policy Options, 2022

4. 2021 Preferred Fiber & Materials Market Report – Textile Exchange

5. 2025 Recycled Polyester Challenge, First Annual Report, 2022

6. NAPCOR Report Shows US Demand for rPET Grew, as Collection Dipped, in 2020

7. Apparel Insider – 2019

8. ISO 22095:2020

9. UL Solutions Research Study – Assessing the Applicability of Analytical Test Methods for Measuring Polyethylene Terephthalate (PET) Made from Recycled Content.